MEASUREMENT OF CHARACTERISTICS AND KINEMATICS OF SEA ICE USING MICROWAVE SATELLITE DATA

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Polar region ocean-atmosphere exchanges are exaggerated when the winter sea-ice cover is parted and the ocean is exposed to brisk, cold winds. Strong relative motion and opening of leads often occurs under high wind-stress divergence. Large resulting fluxes of sensible and latent heat force rapid new-ice growth and thermohaline circulations. In the Arctic Ocean these processes help maintain the halocline by brine production from newly forming ice, while in the Antarctic Weddell Sea in particular, they play a significant role in producing high salinity shelf water, and thereby in regulating bottom water production.

High-resolution (80 m -1 km), visible-wavelength, daylight sea-ice imaging is often prevented by the accompanying cloud cover during critical periods of vigorous regional surface fluxes. Microwave radar satellites are the only uninterrupted source of high resolution (30 m) day and night, and weather-independent data. ERS-1 Synthetic Aperture Radar, 100km-wide images are routinely used to measure ice kinematics and surface conditions in response to meteorological forcing. Drift trajectories of ice floes and open water/ice production rates are measured and validated with field measurements made at a drifting ice camp and by Argos buoys. Examples indicate details of divergence, vorticity and shearing at the 5 km scale, and are corn-piled along orbit swaths and interpolated with buoy drifts to estimate regional- and basin-scale mass transport. Time-series together with opening and closing and meteorological information are then used to estimate regional ice production. Results clearly show that the radar-imaged ice cover responds sensitively to top and bottom forcing.

Recent developments in Lagrangian ice tracking, the promise of 500 km-swath Radarsat images, and enhanced-resolution global imaging by Scatterometers make high-resolution global sea-ice tracking at intervals of a few days a realistic goal. These advances in measuring the dynamics, and growth and decay of sea ice clearly bring significant benefits to the high-latitude ocean processes.

This work was conducted at Jet Propulsion Laboratory, California Institute of Technology and on Foreign Assignment at the Alfred Wegener Institute, Germany, under contract to NASA, Funding support was provided by Robert Thomas (Code YSG) in the NASA Office for Mission to Planet Earth.